



Cairo, Egypt, November 7-8, 2022

MENAPS 2022

MIDDLE EAST AND NORTH AFRICA PERFORATING SYMPOSIUM

Efficiency on Pump-down Plug & Perf Wireline Unconventional Operations





- What is Pump Down Plug & Perf
- Background
- Operational Efficiency and Productivity
- Wireline PnP Pump Down Operations Vs. Conventional perforation
- Challenges
- Maintenance Recommendations
- Processes and Setup
- Execution
- Contingency Plan
- Conclusions

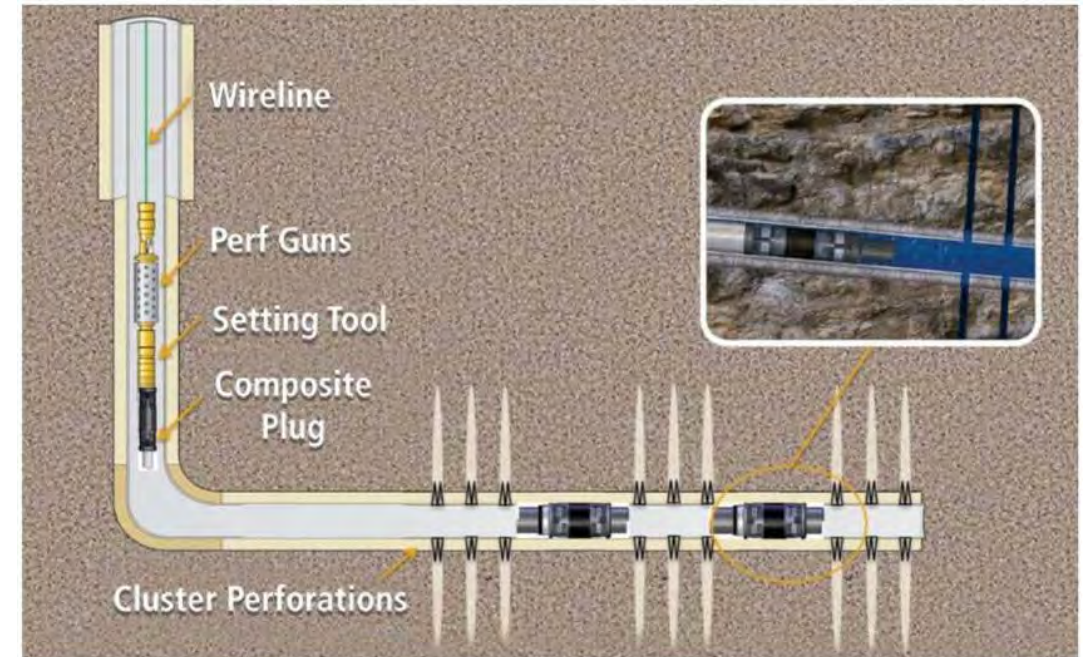
What is Pump-down Plug & Perf

Once a horizontal well is drilled, cased, cemented and isolated, the first communication should be achieved with the formation.

This can be done through:

- 1- E-coiled perforation.
- 2- Wireline perforation with tractor conveyance.
- 3- Utilizing TIV (toe initiation valve) in the completion.

Once done, fluids can be pumped into the formation. Frac will begin to pump fluid and fracture the first stage of the job.

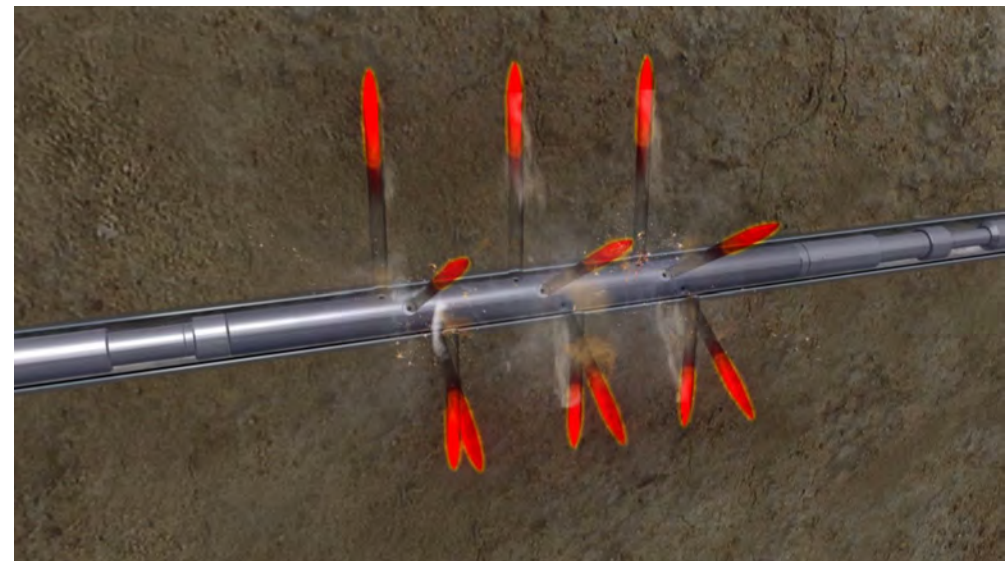
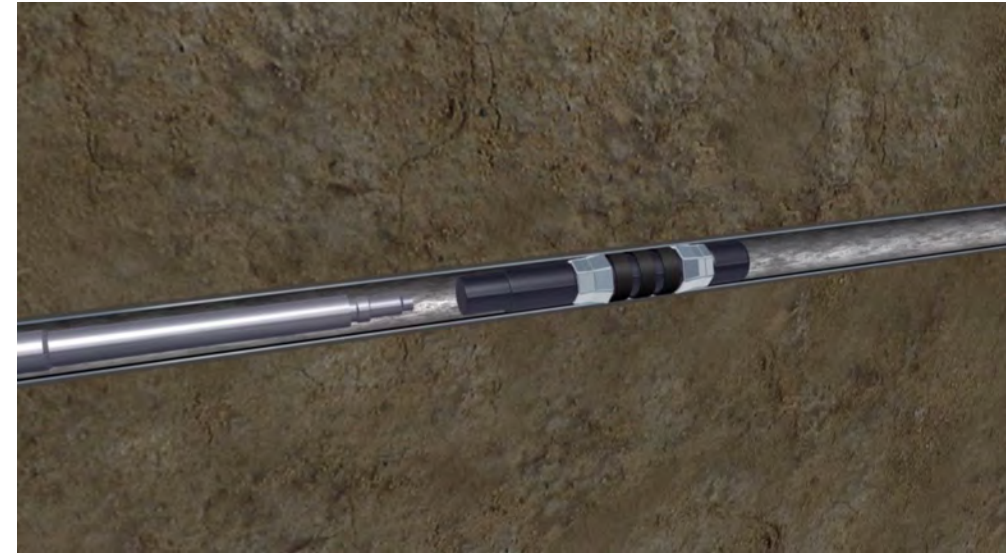
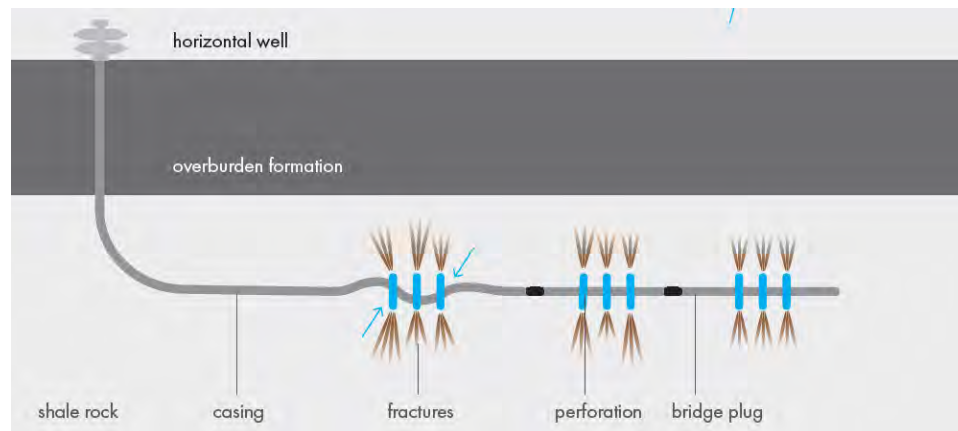


What is Pump-down Plug & Perf

Once the assembly reaches the KOP of the well, fluid will be pumped, with calculated & simulated rates, that increase with deviation, to push the BHA through the horizontal lateral. The BHA will be pumped to the pre-determined plug setting depth.

Once the plug is set in place, the BHA pulled up the hole to the depth of the first set of cluster.

The process will be repeated until all perforation clusters have been fired. then the BHA will be pulled out of the well. Once the well is secure, Frac will start pumping the stage.





- Operations' efficiency and safety is one of the key factors for the success of unconventional reservoir operations with wireline pump-down plug-and-perf projects.
- Although in United States, operations' efficiency has been continuously improving to a high delivery standard; in Middle East, matching the same efficiency, even with same equipment, is not always straight forward, due to the conditions on how the wells are drilled and local country specific regulations and challenges.
- After years of trials by a local client, finally in 2019 United States level of efficiency and service delivery were achieved, all while keeping safety as the primordial factor on a highly efficient operation.
- This presentation describes the process and deployed procedures in place to achieve results and deliver up to 12 stages in one day.



Some definitions....

“**Operational efficiency** is the ratio of a company’s input of resources and materials cost vs the value of measurable output, which determines a system’s overall performance”

While **operational productivity** is focused on increasing the quantity of the services (Stages) delivered, **operational efficiency** is all about increasing the effectiveness and quality of the work you do.

It’s all about delivering as much as you can with the resources available, while reducing the time, material, and energy spent.



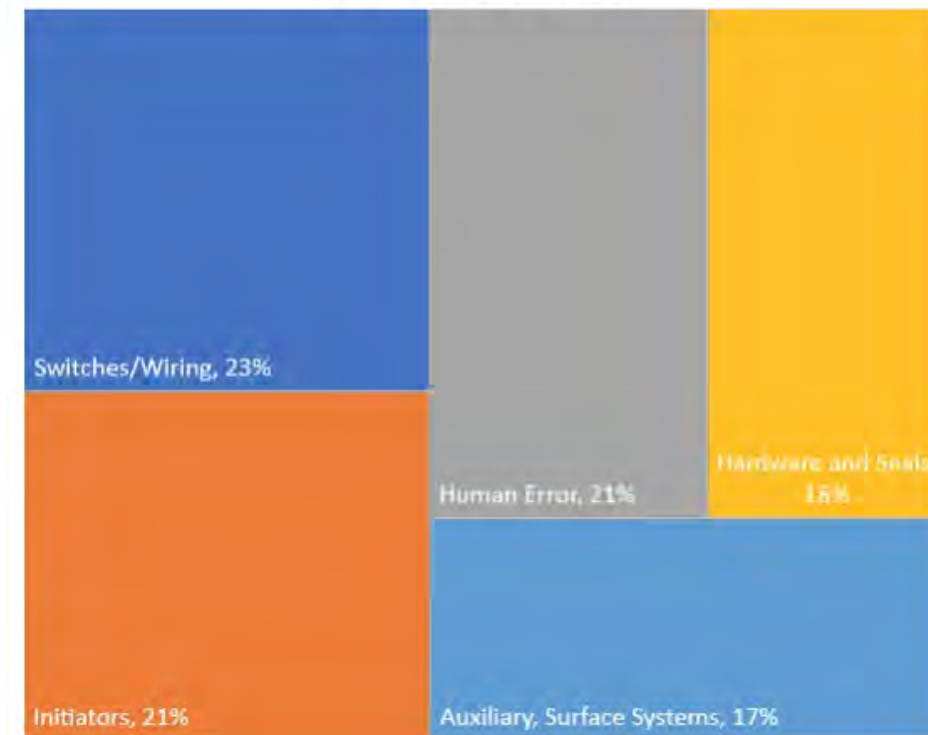
Conventional Wireline Perforation Systems



- Labor intensive in gun shop and field.
- Service quality dependent on experience.
- Account for more than 80% of failures.



Causes of Failures

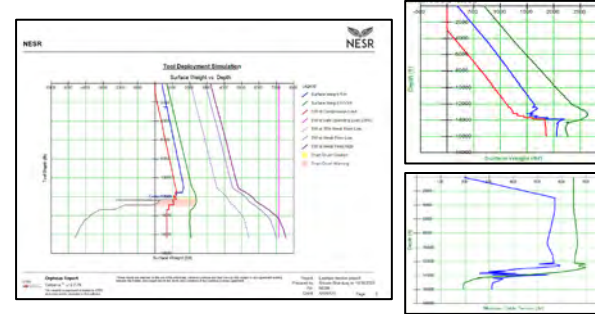


Wireline PnP Pump Down Operations

- New technologies have been adopted and implemented by service providers worldwide to increase efficiency.



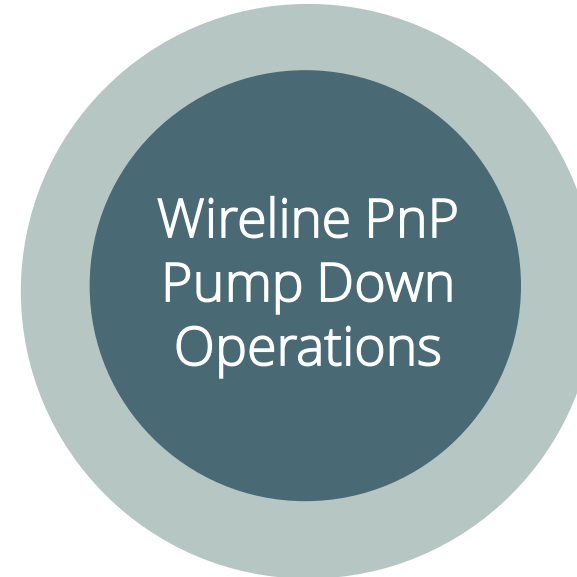
Frac Plugs



Design and Planning



Qualified Personnel



Remotely actuated Hydraulic PCE connections



Plug and Play Gun systems



Slick Cables

Efficiency is achieved by selecting proper equipment and qualified personnel, to minimize assembly and preparation time, while being compliant with all perforating safety requirement.

CHALLENGES

- ✓ Job execution with limitations considerations.
- ✓ Operations run 24/7, increasing the stress on all equipment in use.
- ✓ The capability to react timely and effectively in case of problems and/or minimize incidents' impact.
- ✓ Consistency during the operations



Proper job design and equipment selection



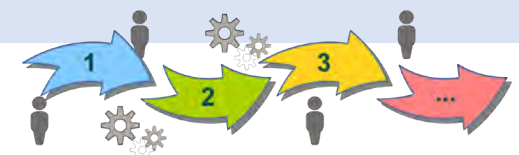
Maintenance Schedule and Turn around time



Contingency Plans in place



Processes, Setup, tools, Training



Execution



NESR

Tool Deployment Simulation

Project: Example wireline project
Prepared by: Shivam Bhardwaj on October 30, 2020
For: NESR of ARAMCO

Field: SDGM
Location: SOUTH GHAWWAR
Country: SAUDI ARABIA
Project Notes: SDGM-1134_5 STAGES_PWP

Project Summary

Well: Camara 1122PP-01H
Tool: Plug and Perforation-01
Calculation Depth: 16365 ft VWD Depth: 16365 ft

Cable Weight	882	WSPF Line Parameter Profile	ESCH
Striking Bar Friction	50 ft	WSPF Line Parameter Profile	50 ft
Tool Joint Friction	22 ft	WSPF Line Parameter Profile	22 ft
Friction Coefficient	0.3	WSPF Line Parameter Profile	0.3
Friction On End	0.3	WSPF Line Parameter Profile	0.3

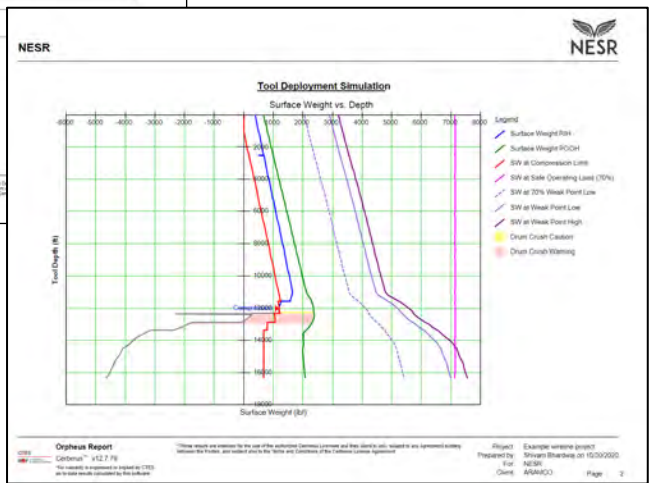
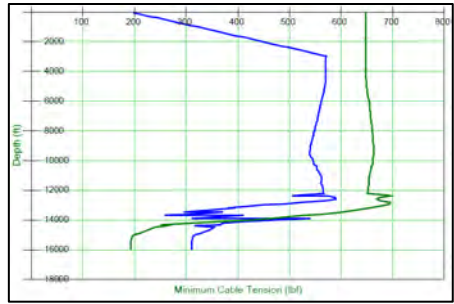
Results Summary

WARNING: Cable compression detected at 11944 ft with tools at 11954 ft. Toolstring can be retrieved to surface from the target depth of 16365 ft.

Diagnosis Report

Caution: +12.7 ft

Project: Example wireline project
Prepared by: Shivam Bhardwaj on 10/30/2020
For: NESR
Client: ARAMCO



- Simulations with all limitations' considerations.
- Tension planner and adjustment during first stages
- Speeds for plugs as per OEM recommendations, review bypass charts and ensure field crews are aware of the limitation.
- Reduce the speed while passing through restrictions.
- Tool-string stoppage, avoid to re-start pump down on horizontal, when possible pull to vertical section and restart.
- Monitor with frac team to properly and sufficiently flush the well after frac.
- In acid frac wells, measure the PH of fluid after frac until neutral before RIH with cable.
- Monitor exposure to temperature, especially for Ballistic Release Tools depending on type of Detonator in use, if RDX exposure time should be monitored closely if BHA stuck (possible low order detonations).

Plug OD 3.858"	Wireline Speed (ft/min)																		
	55	82	109	136	165	191	220	246	273.4	300	328	355	383	410	437	465	492	519	546
3.76	7.91	6.31	4.70	3.10	1.39														
5	11.52	9.92	8.31	6.71	4.96	3.44	1.72	0.17											
6.3	15.37	13.76	12.16	10.55	8.83	7.28	5.56	4.02	2.39	0.81									
7.55	19.07	17.46	15.86	14.25	12.53	10.88	9.26	7.71	6.08	4.50	2.84	1.23							
8.8	22.76	21.16	19.55	17.95	16.23	14.68	12.96	11.41	9.78	8.20	6.54	4.93	3.27	1.66	0.06				
10	26.31	24.71	23.10	21.50	19.78	18.23	16.51	14.96	13.33	11.75	10.09	8.48	6.82	5.21	3.61	1.94	0.34		
11.3	30.16	28.55	26.95	25.34	23.62	22.08	20.35	18.61	17.18	15.60	13.93	12.33	10.66	9.06	7.45	5.79	4.19	2.58	0.98
12.8	34.00	32.40	30.80	29.19	27.47	25.92	24.20	22.65	21.02	19.44	17.78	16.17	14.51	12.91	11.30	9.64	8.03	6.43	4.82
13.8	37.55	35.95	34.35	32.74	31.02	29.47	27.75	26.20	24.57	22.99	21.33	19.72	18.06	16.46	14.85	13.18	11.56	9.98	8.37
15.1	41.40	39.80	38.19	36.59	34.86	33.32	31.59	30.05	28.42	26.84	25.17	23.57	21.91	20.30	18.70	17.03	15.43	13.82	12.22
16.35	43.49	41.89	40.28	38.66	37.02	35.29	33.75	32.12	30.54	28.87	27.27	25.60	24.00	22.39	20.73	19.12	17.52	15.92	

For Casing: 5.5" 26ppf

Description	Unit	Color
Wireline Speed	ft/min	Blue
Pump Rate	gpm (bbl/min)	Red
Annular Velocity	ft/s	Green

Logging Units:

- Weather and environmental conditions.
- Close follow up on operating time.
- Strict Maintenance schedule to be followed based on OEM recommendations, lessons learned, and observations during operations.



Wireline Cables

- Maintenance schedule to be adjusted based on recommendations and observation
- New cable seasoning needs to be strictly followed based on OEM recommendations, lessons learned, and observations during operations.
- Dual Drum is recommended to be able to use same logging unit, if cable needs replacement.

Well Head Pressure control Equipment:

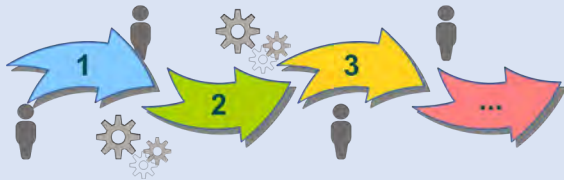
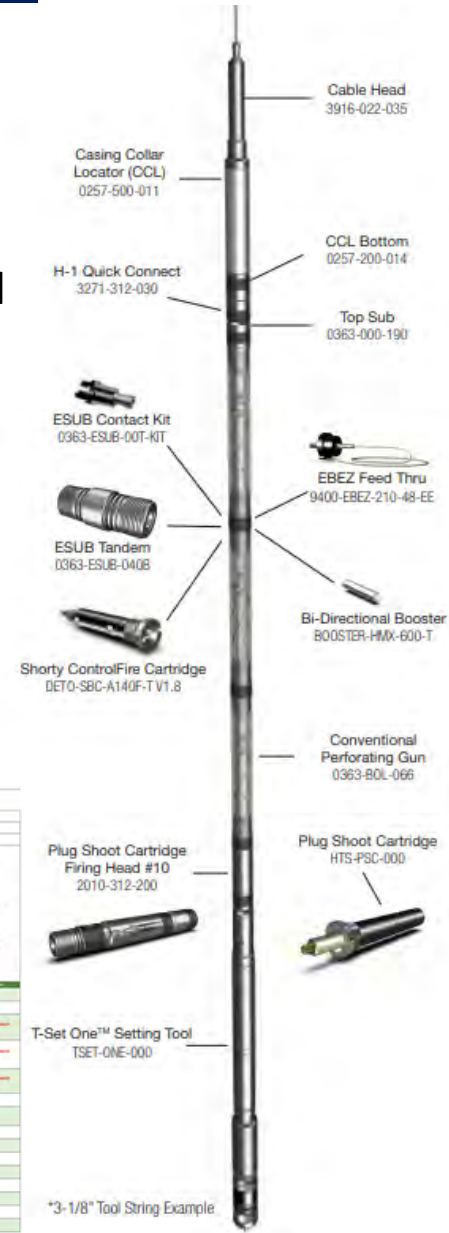
- WHE will require service after a certain number of stages. Failing to do may end on Well control situation. Number of stages will need to be adjusted based on conditions.
- Maintenance during operation to be planned to minimize the impact, while staying between the recommended parameters and limits.



Processes and Setup

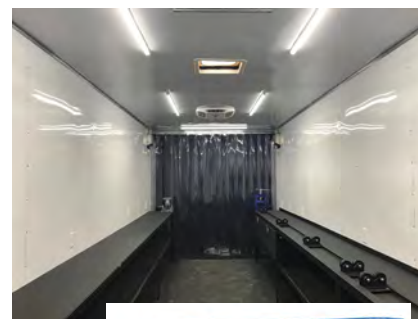
PnP tool string Considerations

- Accessories: Top Subs, adapters and different components traceability is critical. Replacement policy should be in place based on number of runs.
- Release tools, usually ballistically release devices needs to have a specific schedule for redress and replacement of Detonators based on temperature on the well.
- Setting tools service to be completed after every run and periodic MPI to confirm integrity.
- If service is performed by Service company (common in middle east), checklist and peer review needs to be established to ensure consistency.
- Tools and specific design equipment that facilitate the assembly and rig up will impact efficiency highly.



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WIRELINE BRT REDRESS CHECKLIST v 1.0	
Pre-Run Checklist	...
Run Checklist	...
Post-Run Checklist	...
Equipment Inspection	...
Personnel Safety	...
Documentation	...



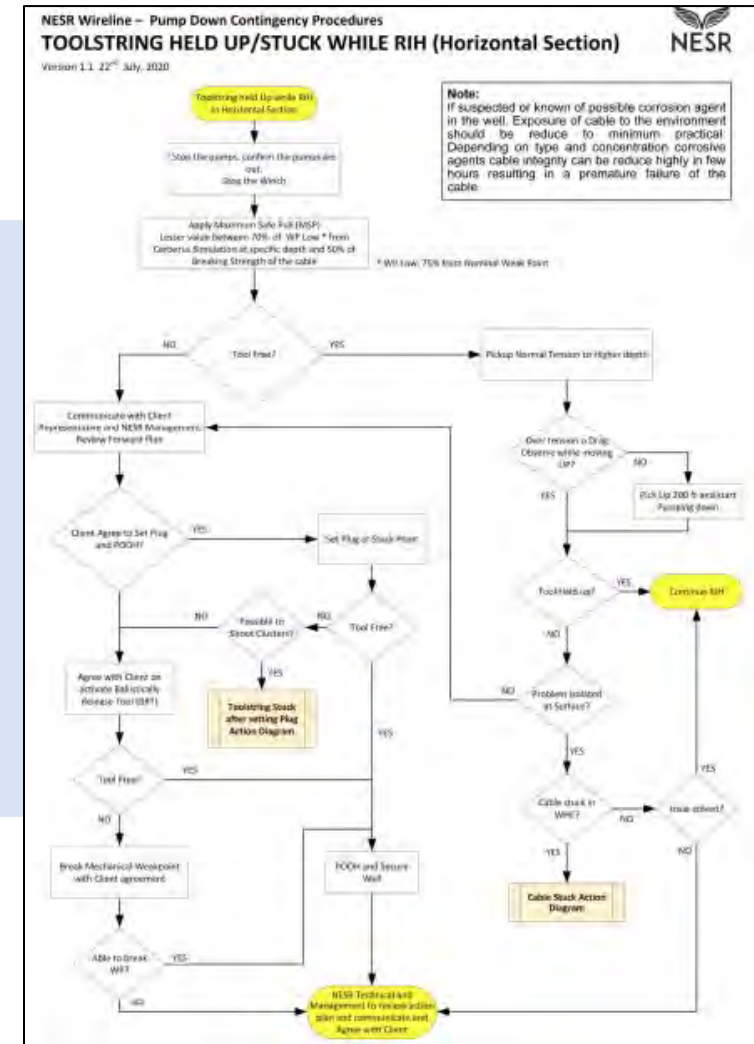
SOPs & Contingency Plan



5. Procedures for Stuck Toolstring Scenarios
 - 5.1. Action Diagram for Toolstring Held up while RIH in vertical Section
 - 5.1.1. Toolstring Held up while RIH in Vertical Section guidelines
 - 5.2. Action Diagram Toolstring Held Up while RIH in Horizontal Section.....
 - 5.2.1. Toolstring Held up while RIH in Horizontal Section guidelines
 - 5.3. Action Diagram for Toolstring Stuck after setting the plug
 - 5.3.1. Toolstring Stuck after setting the plug guidelines
6. Action Diagram for Loss of Grease Seal.....
 - 6.1. Toolstring Stuck after setting the plug guidelines
7. Action Diagram for Cable stuck at Surface
8. Procedure to break the Wireline Mechanical weak point.....
9. POOH with Cable after Weak point release.....
10. Recovering stranded cable stuck in WHE.....
11. How to operate Wireline BOP Manifold.....
12. Pump down PnP Emergency Checklist.....
13. Pump down PnP Stuck Tool Emergency Checklist.....
14. Pump down Operations Work Instruction Checklist

Quality Management System
Standard Operation Procedure (SOP)

Unconventional Operations
Wireline Contingency Plan



- The success of the operation and hence the increase on efficiency will rely not only on the equipment, people but in a set of processes continuously monitored and adjusted to ensure all lessons learnt are captured
 - ✓ Specific Training process for local crews,
 - ✓ Clear and tailored for conditions Standard Operation procedures,
 - ✓ A strong Contingency plan discussed and approved by the client to minimize decision time
 - ✓ Proper design and Simulations
 - ✓ Specific Job Risk assessments updated based on lessons learnt to ensure flawless delivery and compliance.





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Q&A